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ABSTRACT

This comparative examination considers a new era of research on children's learning. How children learn from microcomputers is studied, in light of research on children and television; and such issues are illuminated as how television and computers differ in their historical and economic contexts, how such differences affect their ability to serve children, what some of the developing differences are in research perspectives and emphases given to television and microcomputers, and, given a common research focus on children, what can be applied from knowledge of children as television viewers to their behaviors as computer users. Diffusion patterns for television and microcomputers, and factors affecting their demand and utilization, are compared. A comparison of research on television and microcomputers presents a typology of television research topics and notes that most television studies have emphasized either the effects of television violence on children's aggressive behavior or the relationship between the view of the social world as portrayed on television and children's socialization. Implications for future research and practice are summarized, and 46 references are listed. (LMM)

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COMPUTERS IN THE LIVES OF OUR CHILDREN: THE LEGACY OF TELEVISION RESEARCH

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I. INTRODUCTION: THE HISTORICAL AND ECONOMIC CONTEXT

More than twenty years ago, the landmark study of Television in the Lives of Our Children (Schramm, Lyle, and Parker, 1961) heralded a new era of research in the U. S. on a new technology known as television. Today, in 1934, we stand in a similar moment in research history, roughly five years after the introduction of a new group of computer-based technologies, including microcomputers, videotext, teletext, interactive cable, and microcomputer/videodisc systems. Since it appears that microcomputers will take the lead as a subject of research with children, this chapter will focus on that technology.

Children have demonstrated a remarkable affinity for both television and microcomputers. While they have not been considered a primary audience for much of the television they watch, children have been strong and loyal devotees of the medium. Recent Nielsen data indicate that children between the ages of 2 and 11 spend an average of about 26 hours per week watching television (A. C. Nielsen Company, 1983). This figure, as many have noted, exceeds the amount of time they spend in classrooms and surpasses every other activity done by children, save sleep.

Already, microcomputers are enjoying a similar popularity with children. Young people have been enthusiastic users of micros since their appearance in the late 70's. As with television, while the marketing of computers is directed towards adults who hold the purchasing power, children are frequent and knowledgeable computer-users. (TV ads for computers have taken to acknowledging this phenomenon, with children instructing such high-tech neophytes as Dick Cavett and Alan Alda.)

We know as little today about the effects of computers as we did about TV's effects in the mid-1950's. However, based on the pace with which children are beginning to use computers and the anecdotal accounts of their appeal and educational effects, children's learning from microcomputers has become an important topic for research. The first empirical studies of microcomputers and children are now underway at many universities and research centers.

This chapter considers this new era of research in light of the past decades of research on children and television. While the two media certainly differ as technologies, a comparative examination can illuminate answers to some useful questions. For instance, how do television and computers differ in their historical and economic contexts? How do such differences affect their ability to serve children? What are some developing differences in research perspectives and emphases given to television and microcomputers? And given a common research focus on children, what can we apply from our knowledge of children as television viewers to their behaviors as computer-users?

A. Diffusion Patterns for Television and Microcomputers

This point in the history of microcomputer usage by children is comparable to the period of television's diffusion into American society in the mid-1950's. Figure 1 shows a bar chart of the percentages of U. S. households with a TV set, for every five-year period from 1940 to 1980.

[FIGURE 1 HERE]

As the Figure indicates, near-saturation levels for television's penetration were reached in the early 1960's, with TV sets in more than 90% of American homes. A. C. Nielsen also reports that as of 1983, 89% of American house-

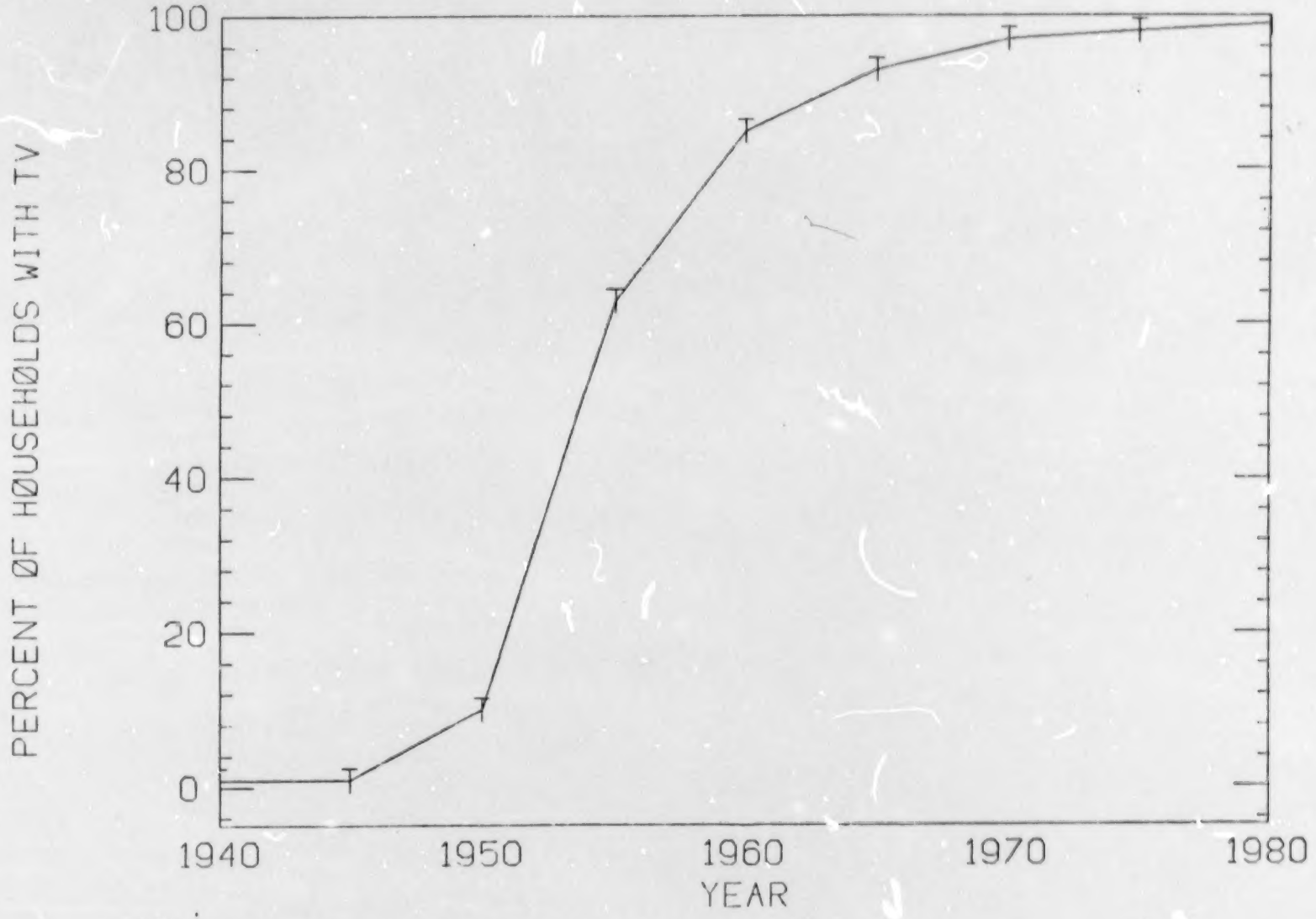


Figure One: Television Sets in U. S.. Households, 1940-1980

Source: Liebert, Sprafkin, and Davidson, 1982.

532

holds had a color TV set, 55% were multiple-set households, and 44% had cable TV. The largest rate of diffusion occurred between 1950 and 1955, when TV ownership surpassed the criterion of 1/3 market penetration often deemed necessary for a popular and profitable innovation.

In 1984, microcomputers will be in the midst of their first decade of availability. While figures on the penetration of microcomputers in American homes change every six months, conservative estimates at the end of 1983 estimate that micros were available in 8% of American homes.

A recent survey by Becker (1983) of a probability sample of 2,209 public, private, and parochial schools offers a more detailed look into the diffusion of microcomputers in schools. Figures II and III summarize data separately for the adoption of microcomputers in elementary versus high schools during the 1980-1983 period.

[FIGURES II AND III HERE]

As the Figures indicate, 42% of elementary schools had one or more microcomputers being used for instructional purposes as of January, 1983; less than 10% had five or more micros. At the high school level, 77% of secondary schools had at least one microcomputer, while 40% had five or more.

B. Comparison of Economic Characteristics of TV and Microcomputers

While the figures above suggest that micros may follow television's path in rapidly diffusing into American homes and schools, they belie some very different processes by which this diffusion is taking place. Adopting an economic framework, important differences in the supply and demand functions of the

MICRØCØMPUTERS IN ELEMENTARY SCHØØLS, 1980-1983

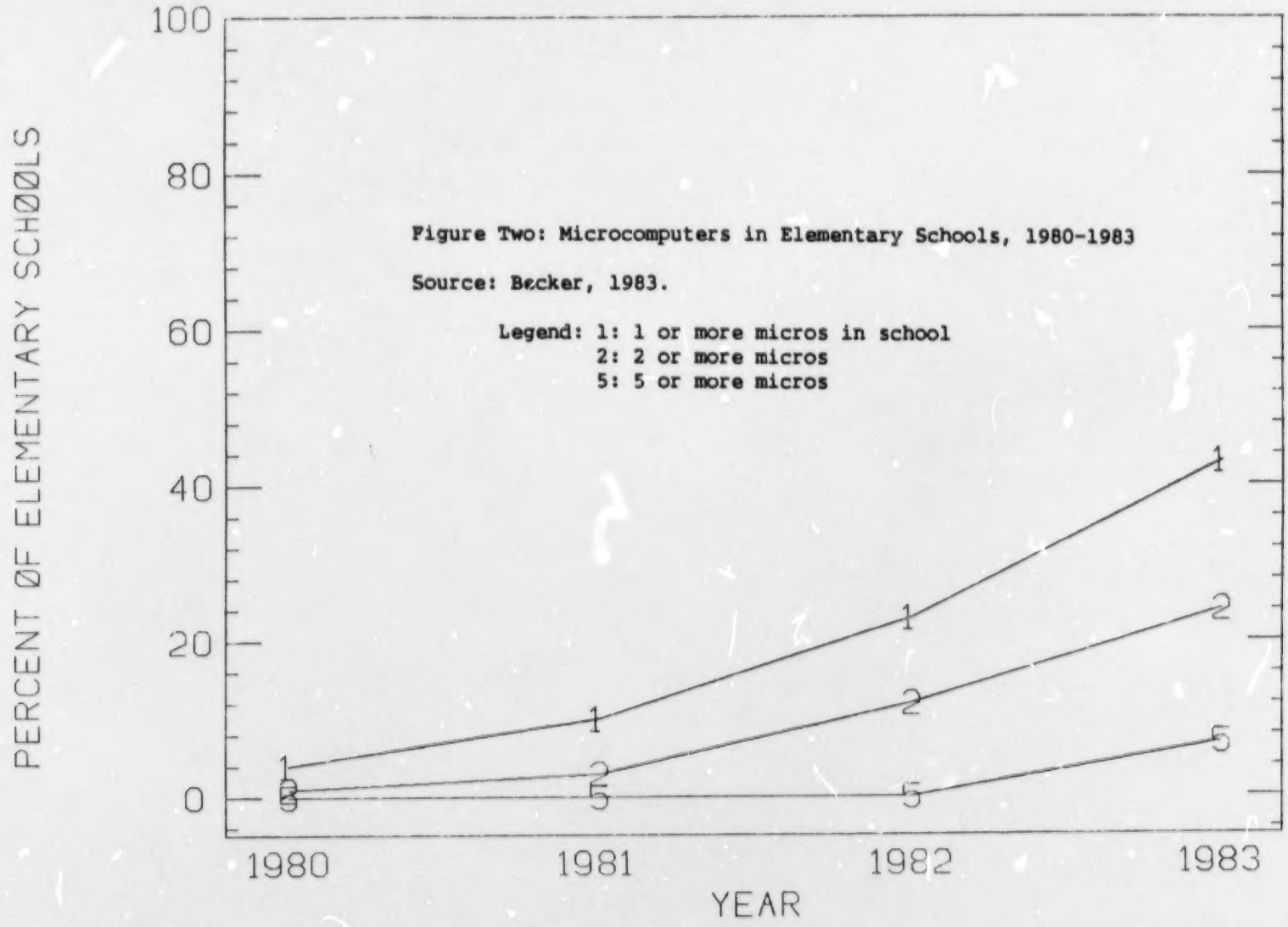
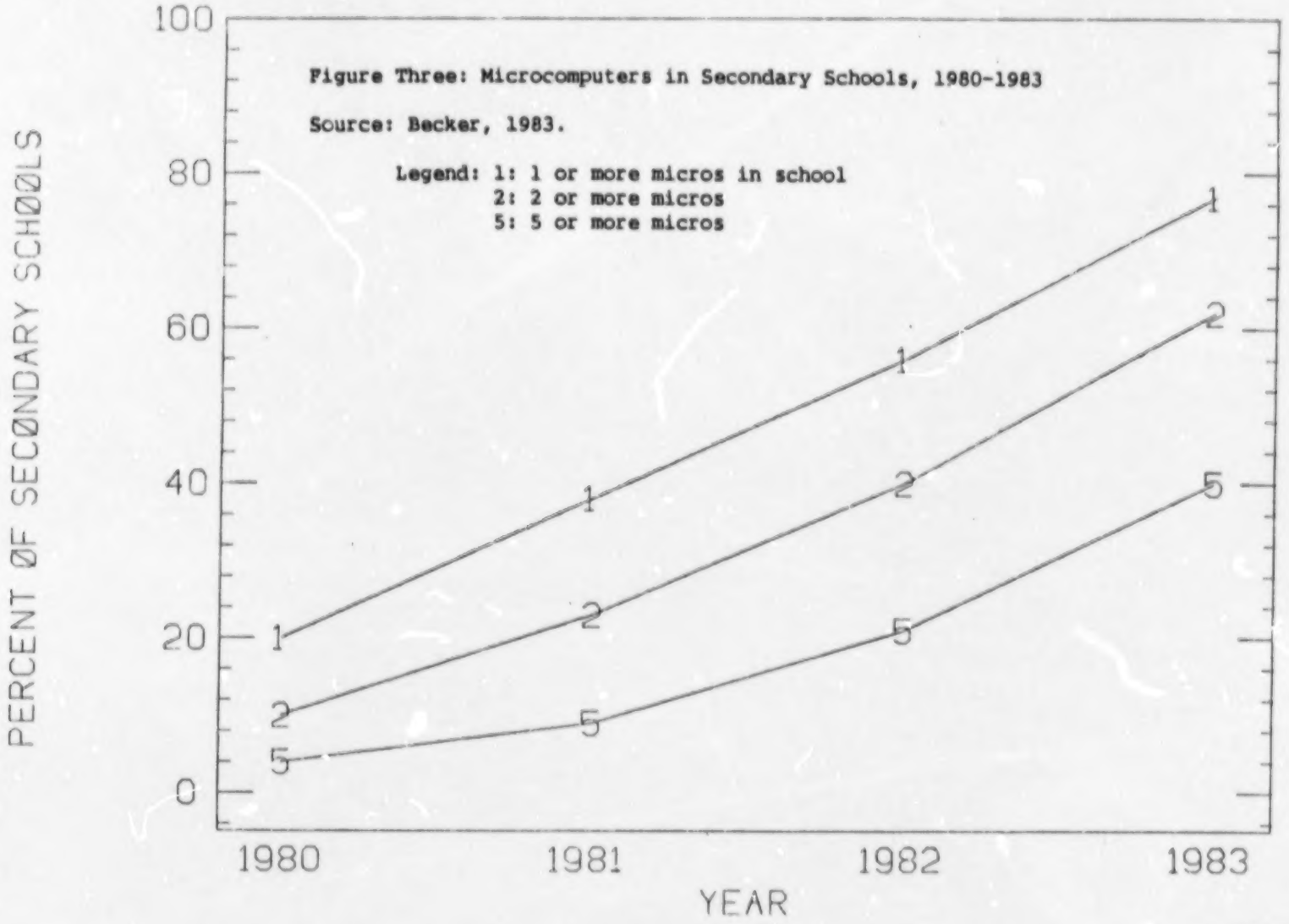


Figure Two: Microcomputers in Elementary Schools, 1980-1983

Source: Becker, 1983.

Legend: 1: 1 or more micros in school
2: 2 or more micros
5: 5 or more micros

MICRØCØMPUTERS IN SECØNDARY SCHØØLS, 1980-1983



television and microcomputer "markets" are affecting these diffusion and use patterns. While a full discussion of the industry structures and economics of these markets is beyond the scope of this chapter, the general distinctions are apparent and useful to state here.

The history of domination of the television industry by the three commercial networks has been well-documented (Barnouw, 1970; Brown, 1971). Network profits derive from the sale of audiences to advertising sponsors, rather than from the direct sale of individual programs to their consuming audiences. Since children do not control a major portion of family spending, they have not been a crucial audience for the supply of programming from networks and their sponsors. Commercial network programming intended for children has been relegated to Saturday morning cartoons and occasional afternoon specials. The child advocacy group, Action for Children's Television, has been among the most outspoken critics of the amount and educational value of commercial network programming for children.

The Federal regulatory mandate over broadcast television has enabled formal governmental inquiry into the effects of television on children. In 1969, Congressional concern over the possible deleterious effects of children's viewing of a high degree of television violence led to the formation of the Surgeon General's Committee on Television and Social Behavior. Under the auspices of that Committee, the most extensive program of social research on a communication medium was undertaken from 1970 to 1972 (Surgeon General's Scientific Advisory Committee, 1972).

Without the profit-making constraints of commercial broadcasters, public television has provided a daily presence of educational programming for chil-

dren. Programs such as Sesame Street, The Electric Company, 3-2-1 Contact, and Mister Rogers' Neighborhood are among the better-known PBS programs for children. In recent years, cable television has offered children's channels (e.g., Warner's Nickleodeon, The Disney Channel), but the long-term profitability and viability of these services remains to be seen.

From the demand side of the television economy, there is essentially no direct cost (beyond the purchase of a TV set) to the consumer for the reception of broadcast television. The consumer pays indirectly to advertisers and networks through the increased price of goods due to advertising costs. Cable television reception does require direct costs to consumers, typically a one-time connect fee, monthly charges for basic services, and additional costs for special programming, including movies, sports, or children's channels.

Microcomputers present a different market picture. As with television, there is a distinction between the manufacture of hardware vs. the provision of software (programming), but the industry relationships are more complex. The industry is dominated by several of the largest computer manufacturers (e.g., Apple, IBM, Atari, Radio Shack, Commodore). These firms not only manufacture hardware but also produce and commission software, both of which are paid for directly by consumers. Since industry standards have yet to emerge, certain microcomputers can run only certain software designed for their own operating systems.

The question of which software programs are available on which machines becomes a critical question for the adoption of computers in homes, offices, and schools. Analogous to television production, software design is a large and growing business of its own.

The educational software market is in its infant stages. It is too early to predict how the market will mature, but some first steps have already been taken in the design of educational programs for children. Some of these programs go beyond drill-and-practice formats descended from a previous generation of mainframe machines and the curricular style known as "programmed instruction." The more creative formats combine the entertainment features of computer games with educational goals (sometimes labelled as "discovery" software).

These early exemplars of educational software correspond to successful children's television programs such as Sesame Street produced in the late 1960's and early 1970's, nearly two decades after the introduction of television. In contrast, educational software for children has become an active sector of the microcomputer market only a few years after the technology itself became available. This early progress in educational software is an encouraging sign that microcomputers may go beyond the limitations of commercial television in expanding educational opportunities available to children.

C. Factors Affecting Demand and Utilization of Micros

As with most technological innovations, the supply and production of microcomputers and types of software will be driven by demand. While the demand for television has been largely a demand for entertainment, usage of microcomputers is based upon more instrumental purposes. Mainframe computers, forebears to today's micros, have an impressive legacy of business, scientific, and military applications. This historical image of computers as an information and educational technology is being carried over in the current educational demand for microcomputers. Among legislators, parents, teachers, and

educators, there is growing opinion that "computer literacy" represents an important set of skills in children's preparation for future schooling and work.

A look back at the experience of instructional TV in schools lends some perspective to the current enthusiasm for microcomputers. In 1977, Dirr and Pedone (1979) conducted a comprehensive survey of ITV utilization and school personnel attitudes towards ITV. Among a national probability sample of 1,700 elementary, junior, and senior high schools, 72% of teachers had ITV available for use in their classrooms ("availability" defined as the presence of both signal and equipment).

Fifty-nine percent of teachers used ITV during the 1976-77 school year, with 46% being regular users of at least one ITV series. Usage was highest at the elementary level. Teachers responded with positive attitudes towards ITV, based on its appeal and motivational interest with students, its educational value, and easy access to reliable equipment. Teachers cited inconvenience of broadcast schedules and lack of appropriate programming as the most common barriers to use.

Even by the standard of this favorable reception for ITV, the current enthusiasm of schools for acquiring microcomputers is astonishing. Compared to television, micros are an expensive technology. Three TV sets and videotape recorders can service the minimal needs of an elementary school, for roughly the same price (under $10,000) as three microcomputers, disk drives, and printers. But this latter set of equipment would scarcely be sufficient for an entire school's computer needs.

Despite the higher per-pupil cost, support for microcomputers is being generated at federal, state, and local levels. For instance, a number of computer manufacturers including Apple, IBM, Tandy, and Hewlett-Packard have donated equipment and training to elementary and high schools, supported by special legislated programs of tax credits.

At the local level as well, school funds are being earmarked for computer purchases. It is not uncommon for computers to be donated by PTA's, community groups, or individual parents. In some cases, the rush to purchase computers has led to a situation where schools have acquired computer equipment but face shortages of software and staff expertise (Wall Street Journal, 1983). Computers are becoming a favored technology at home as well. Parents who might otherwise control and restrain the family's television viewing are encouraging their children's computer use at home and in school.

The fate of microcomputers in classrooms is still very much the province of individual teachers. Based on initial studies such as Becker (1983), it is likely that a similar set of factors to those cited by Dirr and Pedone will affect teachers' decisions to use or not to use microcomputers. While the inconvenience of broadcast schedules presumably does not apply to stand-alone microcomputers, other factors of availability of equipment and desirable software will still be critical. One interesting difference between the two technologies is that while ITV found its highest utilization at the elementary level, thus far, the early stages of microcomputer adoption favor high schools.

In terms of teacher training and preparation, microcomputers require more investment from teachers, relative to television. A teacher giving instruc-

tion in computer programming, word-processing, or others of the more popular uses of micros must devote substantial energy to mastering the hardware and software of that application. Only minimal amounts of techical expertise and preparation time are required to use ITV.

There are some signs that teachers are rising to accept the substantial challenges posed by inviting microcomputers into their classrooms. Increasing numbers of teachers are pursuing computer training and restructuring curricula to accommodate computer applications. Several research reports have pointed to the new roles and responsibilities prosented to teachers through microcomputers (Becker, 1982; Sheingold, 1981). For many of them, the use of microcomputers is injecting a new sense of occupational prestige and professionalism into a tradition-bound profession. For teachers as well as their students, computers are infusing new life into old classroom routines.

These economic, social, and attitudinal factors are affecting not only the ways in which television and computers have entered children's lives. They affect the conduct of research on these media as well. In the next section, we consider some emerging differences in emphasis in television and microcomputer research.

II. A COMPARISON OF RESEARCH ON TV AND MICROCOMPUTERS

Through the 1960's and 70's, research on the effects of television with children was an active area of social research and, judging from the sheer numbers of studies, the most active area of media research. To date, television has been the most closely studied communication medium; children have been its most highly researched audience. The research has attracted scholars from various disciplines, including psychology, sociology, communication, and education. Its progress was substantially aided by Federal concern with the effects of television violence and one million dollars in research funds provided through the Surgeon General's Committee on Television and Social Behavior.[1] Several recent books provide reviews of this substantial body of research (Comstock, Chaffee, Katzman, McCombs, and Roberts, 1978; Liebert, Sprafkin, and Davidson, 1982; National Institute of Mental Health, 1983).

A. A Typology of Television Research

A typology of the topics on which television research with children has been conducted provides an interesting basis of comparison for microcomputer research. The recent summary of television research by the National Institute of Mental Health (1983) cites a 1980 bibliography compiled by Murray (1981) of 2,800 research articles, books, and other materials published in English between 1946 and 1980. Before 1970, 300 titles were published; between 1970 and

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[1] While a comparable level of funding may not become available for microcomputer research, several government agencies and foundations have been early supporters of this research. These include the National Institute of Education, the National Science Foundation, the Spencer Foundation, and the Carnegie Corporation.

1980, 2,500 were published, with more than two-thirds published in since 1975. NIMH estimates that since 1980, another 200 publications have been completed, indicating a continuing level of research interest and activity.

The NIMH report classified the 2,800 studies into these categories, which suggest the outcome or "effects" variables studied:

1. Cognitive and Emotional Functioning
   - --Cognitive Processing
   - --Forms and Codes of Television
   - --Arousal
   - --Emotional Development and Functioning

2. Violence and Aggression
   - --Violence in TV Content
   - --Effects of Televised Violence

3. Imagination, Creativity, and Prosocial Behavior

4. Socialization and Conceptions of Social Reality
   - --Sex-Role Socialization
   - --Age-Role Socialization
   - --Race-Role Socialization
   - --Occupational Role Socialization
   - --Consumer Role Socialization
   - --Conceptions of Violence and Mistrust

5. The Family and Interpersonal Relations
   - --Television's Families
   - --Television's Effects on the Family and Social Relations

6. Television in American Society
   - --Production of Prime Time Television
   - --Public's Attitude Toward Television
   - --TV's Effects on American Social Institutions

7. Education and Learning About Television
   - --Educational Achievement
   - --Television and Reading
   - --Educational Aspiration
   - --Learning About Television

8. Health-Promoting Possibilities
   - --Health Portrayals
   - --Television's Influences on Health
   - --Health Campaigns
   - --Television for Therapeutic Purposes

Not all of the eight categories have attracted equal research interest. The two most extensively researched areas have been 1) the effects of television violence on children's aggressive behavior and 2) the relationships between viewing of the social world portrayed on television and children's socialization. This latter category includes not only content analyses of the social world portrayed on television, but also studies of the effects of television advertising on children's socialization as consumers.

B. Early Directions of Microcomputer Research

We cannot yet build a similar typology for the effects[1] of microcomputers, based on completed studies. However, at least a dozen studies of microcomputer usage and learning now exist, having been conducted during the past five years (Chen and Paisley, in preparation).

Consider the research topics addressed by this new group of studies:

--the diffusion and utilization of microcomputers in schools (Becker, 1983; Sheingold, 1981);

--the effect of computer games on children's motivation and learning (Levin and Kareev, 1980; Malone, 1980);

--the impact of learning a computer programming language on planning and problem-solving skills (Papert, 1980; Pea, 1983);

--the effect of using a word-processor on composing and writing skills (Kane, 1983; Levin, Boruta,

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[1] The term "effects" has had a long and durable history in media research generally and research on television and children specifically (Roberts and Bachen, 1981; Reeves and Wartella, 1982). Its usage can imply a spectrum of relationships ranging from traditional concern with direct and unilateral effects to modern emphasis on indirect and conditional effects. Recent research on television and microcomputers is directed towards the latter, more complex types of relationships. For lack of a better term, "effects" is used here, acknowledging its ambiguity.

and Vasconcellos, 1983);

--the effect of peer teaching and collaboration in programming classes on cognitive and social skills (Hawkins, 1983)

--high school students' attitudes towards computers and the role of computers in society (Anderson, et al., 1982; Study of Stanford & The Schools, in preparation).

Based on this small sample of studies, a noticeable divergence is appearing between the initial research directions for microcomputers and the existing body of television research. Research on microcomputers and their various applications is proceeding without much reference to studies of children's reactions to television. Neither the types of effects explored nor literature referenced in these studies builds on research on the older medium.

Most obviously, research on microcomputers has not begun with television research's emphasis on the anti-social effects of the medium. While complaints have been heard from parents, teachers, educators and even the Surgeon General about possible effects of violence in computer games, effects on children's aggressive behavior have not dominated the research thinking of these early studies.

The topics that <u>are</u> being addressed in the first microcomputer studies also suggest some different research emphases. New "effects" variables are being conceptualized. The nature of the microcomputer stimulus appears as wholly different from television. As the studies of computer programming and word-processing suggest, there are specific applications of microcomputers for which no analogue existed in television programming.

For instance, much current debate and research examines the cognitive consequences of learning to program. Against the grander claims of LOGO's effect on problem-solving and higher-order cognitive functioning (Papert, 1980) are some findings that children encountered conceptual difficulties in the design, coding, and debugging of programs (Pea, 1983). It seems likely that future studies will continue to enlighten this debate as well as expand to other innovative uses of computers in art, music, science and other curriculum areas.

In addition, the Hawkins study points to the substantial research interest in group processes surrounding microcomputer use. Since the economics of computers have not yet allowed schools (and families) to purchase a computer for each child, learning with computers typically occurs through small groups collaborating around a single machine. One outcome has been that traditional classroom structures are being altered to allow students to converse and work together. Claims for the benefits of such collaborative activity are both cognitive as well as social. Relying on the theories of Vygotsky and Piaget, the verbal and other interaction with peers may be providing children with opportunities to formulate and organize their knowledge. Social effects on communication skills and self-image are also hypothesized.

Hawkins' study confirmed that peer collaboration occurred more frequently for classroom computer tasks that for non-computer work, but found fewer instances of actual peer teaching. Her study points to the need for closer examination of the nature of peer-group interactions, the types of information exchanged, and students' beliefs about the appropriateness of collaboration versus working alone.

While group viewing of television is common, these processes have not been well-studied by television researchers. We know surprising little about the group interaction that occurs when a family or a group of children sits down to watch television. The logistics of conducting observations of viewer behavior in private homes have presented substantial obstacles to such research. Fortunately, due to the diffusion of microcomputers in schools, these group phenomena have become accessible to convenient research inquiry.

C. Common Issues in TV and Microcomputer Research

There are, however, some hidden commonalities. Much of the early microcomputer research focuses on their potential educational and pro-social effects. Research on educational aspects of discovery software is the computer analogue to studies of educational television that combined instruction in entertaining formats. For instance, a reading of Malone's findings (1980) on motivational features of computer games comes close to identifying some attributes of appeal discussed in research conducted for Sesame Street (Lesser, 1974; Palmer, 1974).

Early surveys of computer use, learning, and attitudes (Anderson et al., 1980; Study of Stanford & The Schools, in preparation) are in some respects the computer descendents of the first surveys of television use by children (Himmelweit, Oppenheim, and Vince, 1958; Schramm, Lyle, and Parker, 1961). Studies of the diffusion and utilization of microcomputers (Becker, 1983; Sheingold, 1981) are similar in spirit to earlier work on school utilization of ITV.

It is revealing that research on television vs. microcomputers has taken such differing views on the thinking and behaviors of children. At the risk

of generalizing to make a larger point, television research on TV violence and advertising looks at the child under a "media effects" paradigm. The child faces a TV screen in which the programming presents a heavy diet of violent and commercial messages. The challenge for research has largely been to uncover the extent to which children are able to resist the learning of anti-social or undesirable content. As Reeves and Wartella (1982) point out, much of the research has been directed towards the mediating influences between television messages and child viewers and the conditional nature of media effects.

With computers, the child is portrayed as a thinking child. Researchers appear to begin with assumptions of the child as a perceiver and processor of visual and textual information. Their perspectives have benefitted from recent advances in research on cognitive science and child development. Their work reaches into the fields of computer science and artificial intelligence. They are as likely to cite Herbert Simon or Marvin Minsky as television researchers are to reference Albert Bandura or Wilbur Schramm.

The emphasis on children's cognitive processes is one area in which television and computer research appears to be converging. While the computer research begins from this perspective, only recently has television research begun to address questions of the processes by which children learn from what they see. (Collins (1983) estimates that this research area has attracted only 75 published articles or books since 1970.)

In the past few years, television researchers, by focusing upon these cognitive variables, have begun to unveil a new view of the child as an active information processor (Anderson and Lorch, 1983; Collins, 1983; Salomon, 1983). These "active theories of television viewing" offer new evidence to

counter popular views of the passive television viewer presented in past research and lay opinion. The attention to television-viewing as a complex cognitive task begins to resemble the perspective taken by microcomputer researchers. As Collins (1983, p. 9) points out:

> The implications of these views [of the more active viewer] for the study of responses to television have recently caused many researchers to shift their attention from a focus on program content and outcomes of viewing to an analysis of the cognitive tasks involved in viewing particular programs and the ways in which viewers of different ages, with different cognitive abilities, might accomplish these tasks.

Different emphases in research perspectives can be found not only in the types of effects variables addressed, but in attention to characteristics of children's background and experience that act as predictor or mediating variables for such effects. For instance, the variable of age has been the subject of much television research. Much of this concern with age is directed towards achieving an understanding of the developmental nature of children's understanding of television plots, characters, and messages (Roberts and Bachen, 1982; Wartella, 1980). This research has had practical policy implications for regulation of advertising and types of television violence viewed by children of various ages.

Whether research on computers will adopt a similar developmental perspective remains to be seen. As yet, little research concerned with tracking the developmental trends in children's understanding of software has emerged. However, this research area seems a likely one for future studies.

In contrast, the child variable of immediate concern for microcomputer research appears to be sex. Television research also was centrally concerned with boy-girl differences, but the concern with gender differences in microcomputer usage appears to be more pervasive and linked to questions of social equity. It is commonly observed that girls enroll in computer courses, camps, and other computer-related opportunities in fewer numbers than boys (Hess and Miura, 1983; Kiesler, Sproull, and Eccles, 1983; Williams and Williams, 1983; Study of Stanford & The Schools, in preparation). Speculation as to reasons for such differential usage and interest ranges from perceptual and cognitive differences to social and cultural factors. These latter factors point to a computer culture dominated by males and lacking in strong female role models. Other common observations find that much of the current crop of microcomputer games presents themes of aggression and competition that are more compelling for boys than girls. Some researchers point to the differential encouragement given by parents to their daughters and sons to undertake computer activities.

Interestingly, one of the earliest studies of computer interests and attitudes provides some countervailing evidence on gender differences in computer competence and attitudes. Anderson et al. (1982) found minimal differences in computer literacy and programming skill between 8th- and 11th-grade girls and boys in their large-scale survey of Minnesota students. The authors speculated that this lack of sex differences could be traced to Minnesota's state-wide commitment to providing widespread computer opportunities for students. Based on the data for 8th-graders, they also hypothesize that computer learning may not be justifiably categorized with math and science learning. While a drop-off in girls' math achievement and interest typically occurs in the junior high school years, the Minnesota 8th-grade girls continued perform on an equal basis with boys on the computer items.

Computers are not yet the ubiquitous technology that television has become. Given the higher costs of microcomputers relative to TV sets,[3] the effect of a child's socioeconomic status on differential access to and learning from microcomputers has become another important issue for study.

The concern is tied not only to theoretical interest in how children of varying backgrounds can learn from computers, but to policy issues of the equitable distribution of the technologies. In one popular view, competence in using a computer is viewed as a critical skill for a child's future progress and success. Competence with computers is viewed as an "enfranchising" qualification for the information society. Differences in the patterns of adoption and use of computers poses a form of unequal educational opportunity for children from less advantaged backgrounds. Studies by Rogers, Daley, and Wu (1982) and Becker (1983) support beliefs that microcomputers are being purchased in greater numbers by higher-SES families and schools.

Television researchers in the past have also focused on SES, racial, and cultural variables in analyzing television's effects (Greenberg, 1983). But the concern did not reach the question of unequal opportunities. In fact, evidence indicates that children from minority and lower SES educational backgrounds have at least equal access to TV and and view as much if not more television than other children (Comstock et al., 1978).

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[3] While microcomputers are available for less than $200, their memory and processing capabilities do not support much of the more useful and powerful software. At this writing, a fully configured microcomputer system with disk drive and printer ranges between $1,500 and $5,000.

III. IMPLICATIONS FOR FUTURE RESEARCH AND PRACTICE

A. On the Nature of "Interactivity"

The arrival of computer-based media may enable us to revise some older notions about previous media. In particular, videotext, teletext, interactive cable, and videodisc all are altering the ways in which we have regarded what was formerly only a TV screen. As a case in point, consider this often-cited distinction: television is "passive" while computers are "interactive." The distinction is also captured by our terminology for those making use of these media. Those sitting in front of TVs are referred to as "viewers," while those sitting at computers are "users."

As discussed above, recent research supports a view of television viewing as more than mere passive absorption of images, but an active cognitive process. Studies of educational programming such as Sesame Street, The Electric Company, or Zoom have also provided evidence of children's active participation in physical movement, singing, gesturing, oral recitation, and other forms of imitation (Lesser, 1974; Gibbon, Palmer, and Fowles, 1975).

An old chestnut from communication theory holds that "meanings are in people." That is, meaning cannot be derived simply by looking at the message itself. Likewise, we need to refocus our concepts of media passivity/interactivity on the sense-making processes of individuals and not solely on the technologies themselves. For instance, we need to distinguish between behavioral and cognitive activity. A range of overt behaviors can be associated with both media, from motoric behaviors to verbalizations to eye movements di-

rected at the screen. Similarly, a range of cognitive activities that may or may not be accompanied by overt behavior can be specified.

Future research on television, microcomputers, and other media can benefit by moving away from a view of these media as distinct packages of technology to a focus on the specific features of these media that are linked to specific child outcomes. Salomon (1979, pp.5-6) has provided the most coherent articulation of this view:

> Indeed, from institutional, political, or sociological points of view, media are appropriately conceived of as invariant entities. Newspapers are "an institution" and so is television....However, such a global definition of the medium-stimulus is insufficiently differentiated for cognitive-psychological and educational purposes....Something within the mediated stimulus, possibly shared to some extent with other media, makes the presented information more comprehensible or better memorized by learners of particular characteristics.

Features analyses of media move us along the path to an improved understanding of the complex and interrelated nature of television and computer-based media (Bretz, 1971; Paisley and Chen, 1984). Salomon (p. 14) further suggests that analyses of media and their effects address four classes of media attributes:

> all media convey contents ; the contents are structured and coded by sometimes shared and sometimes more medium-specific symbol systems ; they all use technologies for the gathering, encoding, sorting, and conveying of their contents; and they are associated with different situations in which they are typically used.

As the new technologies merge and the video screen becomes a window into an increasing range of entertainment and information alternatives, older distinctions between media will need revision. Research that looks beyond the technology of each new medium to its underlying content and symbols will enable theoretical progress that does not stop at the borders of each machine.

B. The Need for Cross-Disciplinary Research

This developing marriage of technologies may also lead to a merging of research traditions. However, a surprising division is occurring between research communities that studied television and the incipient group of researchers beginning to study the effects of computers with children. The technologies are moving closer together, but few researchers are bridging the gap between the wealth of research on television and the new questions posed by the new media.

As with television, microcomputers pose cognitive, affective, and behavioral questions that are not limited by the ways in which universities classify the behavioral sciences. Television research has certainly been strengthened by contributions from sociologists as well as psychologists, educational as well as communication researchers. It will be important that this cross-fertilization between fields continue into research on the new computer technologies and that opportunities for exchange of knowledge across professional specialties be encouraged. As Paisley (1983) points out, research on these computer-based technologies offers a significant opportunity for the field of communication research to break out of its "ethnocentrism" and expand its impact to other social and behavioral sciences.

The move towards greater cross-disciplinary research may be aided by the need not only for new theoretical perspectives, but methodological ones as well. The new media offer opportunities for innovative research designs, less constrained by previous limitations of technology (Williams and Rice, 1983). One study that may point the way for future research on microcomputers utilized the computer as both stimulus material and data collection device (Lev-

in, Boruta, and Vasconcellos, 1983.) The analysis of children's keystrokes together with field observations of children's writing behaviors provided a new view of children's thought processes and problem-solving strategies.

A final observation on the application of research to practice: while the decades of television research have contributed substantially to our theoretical knowledge of television and its effects, relatively little of it has seen its way to an impact upon programming ideas or practices. With the exception of evaluation research conducted for specific educational children's series, such as Sesame Street, 3-2-1 CONTACT, or Freestyle, television production proceeds largely without application of the extensive academic research on children's reactions to TV. The reasons for this atheoretical approach reside in a combination of both producers' resistance to research and the inability to specify practical recommendations from theoretically motivated studies.

The case with computers may differ. There is some cause for optimism that research on the educational effects of microcomputers may yet be applied in practice. Because the focus of much software for children involves educational aims, research holds promise for illuminating some guidelines, suggestions, and alternatives for software. Opportunities exist for collaborative testing of theory in practical settings at many universities and research centers. These include Berkeley's Lawrence Hall of Science, the Study of Stanford and the Schools, and the Minnesota Educational Computing Consortium (MECC). Such research on classroom use of microcomputers may point to more effective ways of organizing and presenting computer instruction.

In addition, the flexibility with which computer programs can be modified permits revisions based upon child reactions. Several educational software

groups are including a formative research function in their design processes, testing their ideas at various stages of production with target-audience children. These include educational software groups at Bank Street College of Education and CTW's Children's Computer Workshop.

The unique quality of microcomputers is their potential to abolish previous media distinctions by incorporating features of the book, the newspaper, the still picture, and animation. Combining microcomputer control with videodisc or videotape further offers full audio and visual features of film and television. By studying these features acting in concert rather than isolation, research can address broader issues of optimal combinations of text, pictures, and sound that enhance learning. These systems provide us with new microcosms for studying some fundamental questions of education and learning. In that sense, the new media promise excitement not only for the lives of our children, but our lives as researchers as well.

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